Chapter 6: Certification Strategy

6. 1. Introduction

6. 1. 1. Purpose

This section of the Readiness Guide serves as a high-level definition of the certification process that HUD will use to ensure that all of its information systems are Year 2000 compliant. The certification process described in this section is necessary to help HUD achieve consistency of Year 2000 compliance across all systems.

A certified application is one which has undergone reasonable and prudent testing to ensure that a date beyond 1999 will not adversely affect the performance of the system. There is no way to completely test the full functionality of an application. Therefore, certification is not a guarantee that the system will work in all cases.

Application teams should begin the certification process prior to completion of the testing phase detailed in **Chapter 5**. The Kickoff Meeting, which initiates the process, should be scheduled with the Team 2000 Project Office through their division's Year 2000 coordinator.

6. 1. 2. Certification Roles and Responsibilities

Although the Team 2000 Project Office has been established to develop HUD strategies and coordinate Year 2000 work efforts, actual code renovation and testing will be performed by renovation teams consisting of those application analysts and programmers who are most familiar with each individual system.

A certification team will work closely with the application renovation team throughout the certification process and will observe the actual tests whenever possible. The certification team will consist of a project leader, the appropriate IT division Year 2000 coordinator, the Team 2000 liaison, a representative from CSG, and one or more members of the Year 2000 certification team.

The combined certification and renovation team will report results to a c*ertification review board* comprised of the Year 2000 Program Manager and all affected IT Division Directors. The certification review board must sign off on the documentation provided as the final step in achieving application certification. Any conflicts will be resolved by the IT Directors.

6. 1. 3. Certification Documentation

A folder containing documentation for each step of a system's certification process will be maintained by the certification team (See **Table 6-1**). Construction of these folders, following the standardized checklist below, will result in a central point for information on the certification particulars of each system that is both thorough and consistent. This will prove useful not only for the certification itself, but also for future modification, auditing or disaster recovery purposes.

Table 6-1: Checklist of Documentation Items for Certification Folder

		✓
System Description from Status 2000	**C**	
Description of date usage within the system (including renovation approach)	**A**	
Certification Date Checklist	**A,C**	
Compliance to Standards Checklist	**A,C**	
HUD System Interfaces - describe date data transferred or shared between systems	**A**	
External System Interfaces - describe date data transferred or shared between systems	**A**	
Summary of Certification process by Certification Team - describe all stages beginning with test plan review and certification testing process (including failed tests)	**C**	
Test Plan and review comments (A sample test plan template is available as an attached document in the reference library of STATUS 2000; see Readiness Guide Reference I for more information about STATUS 2000.)	**A,C**	
Test Request Form	**A**	
Test Results Documentation (screens, reports, etc.)	**A,C**	
Sample of modified source code	**A,C**	
User acceptance letter for use of two digit dates on screens and/or reports	**A,C**	
COTS letter from vendor, if applicable	**A,C**	

* Column denotes responsible party: **A** = Application Team, **C** = Certification Team

6. 2. The Year 2000 Testing and Verification Challenge

6. 2. 1. Critical Test Disciplines and Essential External Verification

Verifying and certifying that an application, device or process is Year 2000 compliant is an essential part of the conversion process. Yet, technology professionals admit that testing has been one of the weakest disciplines of information systems. Making the task even more difficult: we're not only trying to change and test code today, but we're also testing it for future scenarios that are hard to create and harder to verify.

When all the possible tests that should be run in a Year 2000 project are identified the list becomes formidable. These tests include regression, future simulation, integration, performance, and reverse millennium or parallel testing (running or re-running 1990's data or jobs after January 1, 2000).

Additional computer and personnel resources may be necessary for this task. Even so, with the set of possible tests being virtually unlimited, decisions will be needed on exactly what to test, what test disciplines to self-impose, and what methods to use for external verification. These decisions become critical in the face of time and cost constraints.

6. 2. 2. Developing a Formal Audit Process

A formal audit process is used to examine and certify the scope, timing, path coverage and results of testing. Time and resource constraints limit the extent of testing. Within those limits, a process that formally monitors quality in a time-efficient yet effective manner must be implemented.

These procedures are recommended to ensure an application has retained original functionality. The certification team will not require these procedures for an application to achieve certification.

Year 2000 certification is a validation project that must ensure the following basic procedures were addressed:

1. Where possible, test the baseline version of the application unit prior to conversion. This establishes a baseline set of output data to validate against the converted version of the application.
2. Any necessary adjustments in the test data used in Step 1 and a retest of the baseline version to ensure application coverage and reliability of results.
3. Execution of the converted application against the identical test data used to test the baseline version of the application. Identical results will help ensure the original functionality of the application has been retained. This may not be possible where Year 2000 changes have been merged with other functional modifications.

Automated testing tools should be used whenever possible to facilitate the comparison of outputs from the baseline and renovated code tests. The certification process does not test to validate that the application is completely functional beyond its baseline measurement.

Testing is required to ensure the renovated application works for dates after 1999 and also works in a Year 2000 compliant environment. Specific dates to test for are defined in the **Certification Date Test Checklist** (See **Table 6-2**).

6. 3. Year 2000 Compliance

6. 3. 1. Year 2000 Compliance Definition

HUD embraces the Federal Acquisition Regulation (FAR) definition of Year 2000 compliance:

> *Year 2000 compliant means information technology that accurately processes date/time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations. Furthermore, Year 2000 compliant information technology, when used in combination with other information technology, shall accurately process date/time data if the other information technology properly exchanges date/time data with it.*

An application system will be deemed compliant if it is able to compute HUD business rules accurately before, during, and after January 1, 2000 regardless of whether dates are received from the computer's operating system, a data repository, an external interface, or user input.

6. 3. 2. Documentation of Application Failure Dates

HUD also requires the explicit documentation of application failure dates. The failure date is the date on which the application will fail due to date logic. For example, a fixed windowing technique using the range of 1950-2049 will fail in 2050. It may fail sooner in cases, like mortgages, where future dates are calculated. For more discussion of Windowing, see **Chapter 2** (**Application Analysis**) and the **Standards for Year 2000 Conversion / Year 2000 Technical Panel**, **Document E** in the **Reference Library**.

6. 3. 3. Year 2000 Certification Scope

All systems will be required to undergo Year 2000 certification, including those considered to be Year 2000 safe and not requiring renovation. For those systems that have completed the renovation process or were originally built to be compliant the certification process may be altered from the procedures described below. Commercial off-the-shelf systems will follow a modified certification process as well.

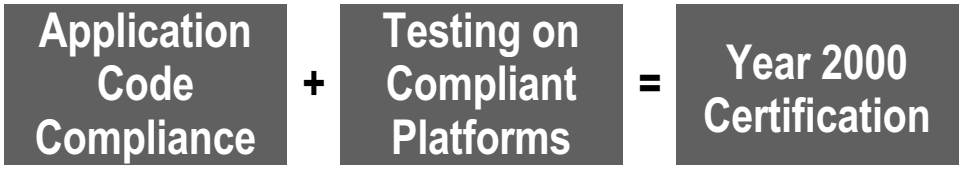
6. 4. Requirements for Certification

An application is Year 2000 certified if:

1. The application code has been certified as compliant, and
2. The application has been tested on a Year 2000 compliant platform for all appropriate date scenarios.

The elements of this equation are graphically depicted in **Figure 6-1**.

Figure 6-1: Year 2000 Certification Testing Equation



Application code compliance is obtained when proper Year 2000 test methods are employed and successful results are achieved.

Platform compliance is obtained once an application has been tested successfully (including forward date simulation testing) in a Year 2000 compliant environment. An environment includes operating systems, sub-systems (e.g., CICS), database management systems, and third-party interfaces upon which the application is dependent. Application compliance may be awarded separate from platform compliance; however, an application is not certified until it achieves both application and platform compliance.

6. 4. 1. Application Testing

HUD requires applications undergoing Year 2000 renovation to test for Year 2000 specific issues.

HUD recommends testing to ensure that original functionality has not been degraded by the Year 2000 renovation effort.

HUD requires applications developed to be Year 2000 compliant to undergo Year 2000 testing on a compliant platform in order to receive Year 2000 certification.

The Year 2000 certification team will verify that renovation teams have performed the following requirements in a compliant environment:

- ➤ When possible, parallel test results indicate that the system has retained its original functionality after renovations according to functional and technical specifications.
- ➤ Expected results were achieved when test data was aged to December 31, 1999; January 1, 2000; February 29, 2000 and beyond.

- Expected results were achieved when the system clock was advanced to simulate crossing of the century boundary (system operates during transition from before December 31, 1999 to after January 1, 2000). In some cases, this test can be achieved through the use of date simulation software.
- Expected results were achieved when leap year/non-leap year dates were used. For example, system date of 2/29/1996, 2/29/2000; test data date of 2/29/2000; finding day of the week for 3/1/2000. For non-leap year dates, what day of the week is after 2/28/2001; what date is 1 day after 2/28/2001? (There are 3 levels of leap year rules: 4, 100, and 400. Every fourth year is a leap year. The every fourth year rule is not valid if the year is divisible by 100, such as 2100 or 2200; but it is valid if the year is divisible by 400, such as 2000 or 2400.)
- Expected results were achieved (e.g., error conditions) when invalid dates were applied. For example, 4/31/2001, 2/29/2001, xx/xx/19xx.
- Year 2000 date standards are followed or exceptions justified and authorized.
- Applications performing date calculations have been tested and expected results achieved for the condition where one date is pre-2000 and one date is post-2000. For example, elapsed time between 12/31/1999 and 3/31/2000.
- If appropriate, test activities performed on a yearly, quarterly, monthly or weekly cycle.
- Applications performing specific activities based on the day of the week need to be tested. By adding 28 years to existing test data, future test dates will fall on the same day of the week.
- Any program using the system date must retrieve in a 4-digit year format using one of the following standard techniques:
    - On the Hitachi, the U001 function of TransCentury will retrieve the date. CICS programs can also use the FFORMATTIME CICS function. Non-CICS programs can use IGZEDT4.
    - On the UNISYS platform, C$CURRDATE, or the extended COBOL ACCEPT statements will return the 4-digit year. Any program already using TransCentury can also use the U001.
- All associated bridge programs that produce input to or output from the renovated application have been executed and tested. This includes ensuring that appropriate precautions have been implemented to prevent invalid data being received as input by HUD's applications.

The certification team will maintain a *Certification Date Test Checklist* (like the one shown in **Table 6-2**) based on the certification criteria identified above. The test and certification teams will work together in the certification walk-through to review the checklist and verify whether or not Year 2000 certification requirements were met.

The Year 2000 certification team is responsible for collecting and maintaining documentation of each system's certification process; these records are stored in the Team 2000 Project office. (Refer to the **Certification Packet**, available electronically from *STATUS 2000*, for more information about what is maintained in each system development project's **Certification Folder**.)

Table 6-2: Certification Date Test Checklist

✔	Date Format	Condition
	1998	Confirm the application still works with current dates.
	12/31/1999 09/09/99	Some applications were designed to store specific dates to represent an invalid or special value. After conversion, the system must be able to recognize and handle these dates correctly.
	01/01/2000	The applications must work with the first day of the next decade.
	02/29/2000	The applications must be able to recognize this day since year 2000 is a leap year.
	03/01/2000	This serves to verify if 02/29/2000 was indeed recognized. An important thing to watch out for is the day-of-week for this date. March 1, 2000 is a Wednesday.
	10/01/1999, 09/30/2000	If relevant, the application must recognize 10/01/1999 and 09/30/2000 as the beginning and end of fiscal year 2000.
	12/31/1999, 3/31/2000	Confirm date calculations for elapsed time are performed correctly when one date is pre-2000 and the other is post-2000.
	1999, 2001	Confirm that non-leap years are handled correctly.
	4/31/1999	Confirm the handling of invalid dates.
	2001	Check if the application accepts other 21st century dates.

6. 4. 2. Compliance to Standards

Table 6-3 is a checklist used to indicate compliance to Year 2000 standards derived from the *HUD Standards for Year 2000 Conversion* document (Document E in the Reference Library). This checklist, along with the checklist in **Table 6-2** above, provide the certification team the means for determining certification compliance.

Table 6-3: Compliance to Standards Checklist

Yes	N/A	Item
		Estimate costs/benefits before approach is chosen.
		Estimate impact on storage and performance estimated before approach is chosen.
		All calls for system date return 4-digit year (through TransCentury standard date routine or call to compliant O/S).
		Inter-agency data exchange uses 4-digit year.
		Inter-system data exchange uses 4-digit year or the reason for an exception is documented.
		Inter-system data exchange has been decided upon by both sending and receiving systems.
		Requests for new exceptions to the standards have been sent via cc:Mail to Team 2000.
		All impacted dates have been identified and addressed.
		Code has been examined for use of hard coded dates and switches such as 99 and 00
		Renovation approach has been identified to Team 2000 via cc:Mail.
		Application has created external bridges to and from other systems as necessary.
		Bridges use conversion routines from TransCentury.
		The approach to date fields in a database has been coordinated with affected users and DBA's to establish the procedures for using the fields.
		Testing has included simulation of the recommended future system dates.
		Application code has been examined for the use of dates in sorts or internal keys.
		Approach to handling any archived data has been determined.
		Sample modified source code documented to HUD standards is provided.
		Date usage within the application has been described.

6. 4. 3. Validation Strategy

Validation can be either a single pass or a dual path process. A **single pass approach** to testing is recommended for renovations that use a procedural workaround (windowing) approach to conversion, are not highly date dependent, and use few bridges.

A **dual pass validation strategy** is recommended for testing the more complex renovation projects and all projects using a field expansion solution for the conversion process. It cannot be used if non-Year 2000 changes have been merged with Year 2000 changes.

The **first pass** validates the results of executing the renovated code against the results of running the identical test data against the baseline version of the application to ensure original functionality has been retained (functional equivalence testing).

The **second pass** validates the renovated code for compliance issues. Attempting to test for both objectives in a single pass can lead to ambiguity of results and increase the difficulty in locating incorrect code.

The benefits of each approach are listed in **Table 6-4**.

Table 6-4: Benefit Matrix: Comparison of Single and Dual Pass Validations Strategies

Comparison Factor	Single Pass Validation	Dual Pass Validation
Maintenance	Application has required low levels of maintenance	Upgrade units are constantly under maintenance
Renovation Strategy	Procedural work around (windowing) was used for renovation	Extensive date field expansion
Test Data Complexity	Uncomplicated test data sets	Complicated test data sets
Date Dependence	Upgrade unit is not highly date dependent	Application is extremely date dependent
Year 2000 Change Scope	No changes other than for Year 2000 were applied	Changes outside Year 2000 were applied
Bridges	Few bridges were used in conversion	Many bridges were used in conversion
Update Unit Size	Update units were small and are easily validated	Update units were large and are not easily validated
Date Horizon	Date horizon is too close to apply dual-pass strategy	Date horizon is sufficiently wide to apply dual-pass strategy

6. 5. The Year 2000 Certification Process

The certification process is comprised of six steps during which the certification team and the IT development team will address the application's date functionality, system interfaces, test plan, system documentation, and test results as they pertain to Y2K issues. Large systems may repeat steps in the process as portions are renovated, certified, and implemented in manageable phases. Those steps are:

1. Kickoff Meeting,
2. Submission and Review of Test Plan,
3. Precertification Meeting,
4. Certification Testing,
5. Certification Walk-Through, and
6. Certification Review Board Sign-off.

6. 5. 1. Kickoff Meeting

The first meeting with the certification team should occur prior to finalization of the detailed certification test plan. The purpose of the initial meeting is to ensure all necessary century safe tests are included in the test plan to enable the application to achieve Year 2000 compliance. The **Certification Date Check List** and **Compliance to Standards Checklist** are reviewed.

Attendees of this meeting will include the renovation team, test team (if different), CSG, and the Year 2000 certification team.

In the kickoff meeting the certification team will present an overview of the certification process, describe the required date testing scenarios and adherence to standards checklist. The IT development team will describe the date functionality of the application, identify system interfaces, describe the approach to testing, and set a date for delivery of the test plan to Team 2000 for review.

All system dependencies must be identified by the application teams. Dependencies include: Year 2000 compliance of operating systems, database management systems, third-party utilities, common modules, tape management systems, hardware platforms and hardware interfaces.

6. 5. 2. Submission and Review of Test Plan

The IT development team will submit a detailed test plan on or before the date agreed to at the kickoff meeting (See **Section 5.5.1**). The certification team will review the test plan to ensure all necessary date testing scenarios have been incorporated and the plan conforms with the guidelines determined at the kickoff meeting. The certification team will respond with comments within five work days.

6. 5. 3. Precertification Meeting

The precertification meeting should be held prior to certification testing to ensure all pertinent Year 2000 issues and dependencies are addressed. Test plans, procedures, and testing scenarios are finalized based upon application date functionality, system interfaces, and platform environment. The IT development team project leader, IT technical lead, CSG, and Team 2000 should attend.

The IT development team project leader will provide a description of the date functionality within the application (including application failure date), a list of external and internal interfaces, a description of any necessary bridges, and a plan for how all of these will be addressed in testing.

The certification team will review these items and identify the specific date scenarios to be tested. In addition, a date will be set for the application team to submit a test request form and a target date for certification testing will be established.

6. 5. 4. Certification Testing

The application is tested in a Year 2000 compliant environment using the appropriate date scenarios as identified in the precertification meeting. The Year 2000 project office will not conduct the tests. The project's certification team will support test teams in planning for Year 2000 specific testing and will observe the testing procedures whenever possible.

The testing process should follow the guidelines detailed in **Section 6.4.1**. The resulting output will be presented to the certification team for review at the certification walk-through.

6. 5. 5. Certification Walk-Through

After a system has completed certification testing, the application test team will conduct a certification walk-through with members of the Year 2000 certification team. The test team will present test results documentation which demonstrates that all of the test conditions were conducted successfully. The results will be reviewed at the meeting by the certification team. The team will prepare a certification report based upon walk-through results and will present them to the certification review board.

The test results documentation should include:

- ► Test plans,
- ► Test conditions,
- ► Test scripts,
- ► Samples of test data used,
- ► File comparisons,
- ► Database area comparisons,
- ► Screen prints,
- ► Output reports,
- ► Summary of test results, and
- ► Report of any discrepancies between pre-renovated and post-renovated system results.

The certification team will also need on-line access to (a copy of) source code to verify adherence to the HUD Standards for Year 2000 Conversion. Specifically, the certification team will check random programs for those items in the **Compliance to Standards Checklist** found in **Table 6-3**.

Pending successful results, the certification team will note the appropriate level of compliance:

- ► Compliant application,
- ► Compliant platforms, or
- ► Year 2000 certified (both compliant application and platforms).

If certification is not met by a system, the test team must address the areas of their test process that were found to be noncompliant. For example, if a test team does not include a test condition for leap years, it must retest the applicable programs for that test condition. The test team will not be required to retest all test conditions. If time does not permit retesting of the current release of a system, retesting can be postponed until the next release is scheduled.

The test team can then request a second certification walk-through and address solely those areas that were identified as problem areas in the first walk-through.

Compliance and certification status will be tracked by the certification team and posted on the Year 2000 project HUDweb page at the following address: (*http://hudweb.hud.gov/po/it/2000indx.htm*).

6. 5. 6. Certification Review Board Sign-Off

Certification sign-off formally takes place when all material has been reviewed and validated by the certification team and the certification review board has granted approval. The sign-off by the review board verifies that the renovation team has addressed all pertinent Year 2000 issues and has tested dates beyond December 31, 1999 in a Year 2000 compliant environment.

6. 6. Certification and Release Schedules

While certification will be required of all systems, application development teams do not have to wait until certification is complete before migrating applications or parts of applications to the production environment. In other words, it is possible for an application to be implemented prior to certification. It should also be noted that applications that do not meet all of the criteria for certification may delay re-testing for certification until the application's next scheduled release.

6. 7. Recertification

HUD must ensure that systems which have been certified Year 2000 compliant remain Year 2000 compliant. Below are several modifications which could impact a system's compliance status and necessitate recertification:

- ➤ Addition of major new functionality;
- ➤ Changes to interfaces with business partners;
- ➤ Corrections to fix previously detected Year 2000 compliance problems;
- ➤ Addition of date fields to the system.

6. 7. 1. Procedures to Build Continued Awareness

Continued awareness of all pertinent Year 2000 issues on the part of project leaders is critical in retaining system compliance. Team 2000 must be certain this awareness is incorporated as part of the normal development process:

1. IT project team leaders must be made aware of the necessity of incorporating established Year 2000 certification testing procedures, methods, guidelines and date forwarding into all subsequent test cycles for certified applications undergoing further development for a new production release.
2. Results of original certification testing must be retained for comparison with subsequent input and output results. The new results should be identical to the original results; any differences must be reconciled.
3. IT project teams must be certain that no new errors are introduced into the modified code.
4. Interfaces and bridges must continue to function properly.

6. 7. 2. Procedures to Determine Recertification

If the guidelines above have been followed, a certified application may not need to be recertified when further modifications have been made to it. For Team 2000 to determine whether recertification must occur, the following procedures need to be followed:

1. The project leader must send an electronic mail message to the Team 2000 mailbox, informing the certification team that a previously certified application has been modified and released into production. That message should include:
   - ➤ A description of the modifications made to the application, especially as the changes relate to the date functionality of the application and date data field changes; and
   - ➤ A brief description of the test results that will be provided to the certification team proving the application has been tested in a Year 2000 compliant environment.
2. The documentation provided by the project leader (including a sample of the documented modified source code) is reviewed by the certification team.
3. The certification team determines, from the documentation provided, whether or not the application or portion of the application must be recertified. This determination will be based on the following:
   - ➤ The degree to which automated change management procedures reduce the risk of reversing out previously certified changes;
   - ➤ The degree to which application testing protocols include advance date testing;
   - ➤ The ability to demonstrate through automated logic path mapping or impact assessment that change has not occurred to date logic.

6. 8. Regression Certification Testing Period

During FY1999, after all HUD systems have been certified, Team 2000 plans to conduct "regression certification" testing. In that period, a copy of the production environment will be set up and all systems will undergo Year 2000 compliance, forward-date testing one last time. This follow-up testing should even further decrease the possibility of system failure in the new century. This testing is different than and independent of any and all recertification testing and does not preclude or obviate the need, rules or procedures of recertification.